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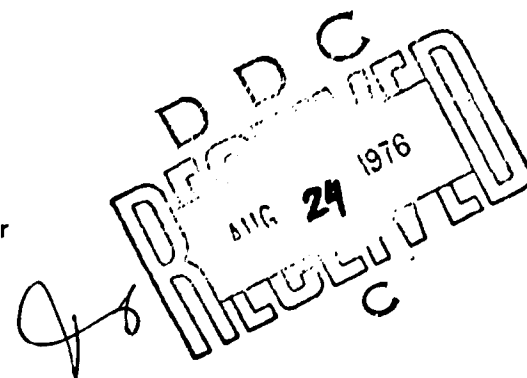
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# A COMPARISON BETWEEN A STANDARD MAP AND A REDUCED DETAIL MAP WITHIN A SIMULATED TACTICAL OPERATIONS SYSTEM (SIMTOS)

Thomas M. Granda

Raymond C. Sidorsky, Work Unit Leader



BATTLEFIELD INFORMATION SYSTEMS TECHNICAL AREA



U. S. Army

Research Institute for the Behavioral and Social Sciences

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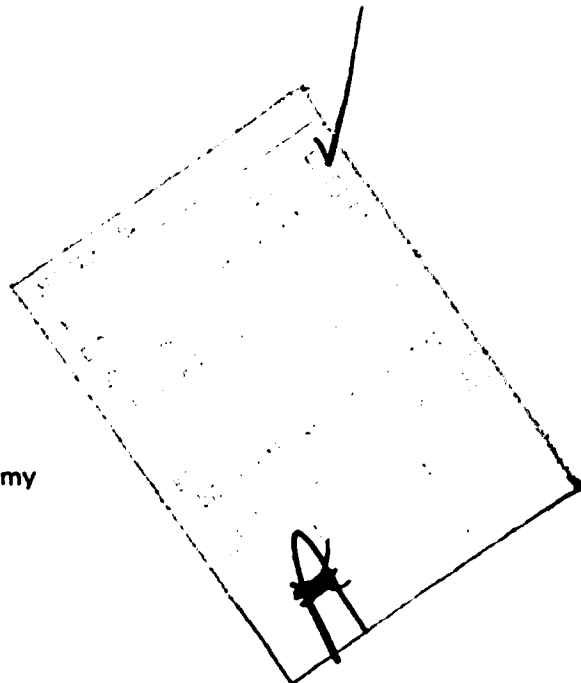
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The use of reduced maps in place of standard Army maps has often been recommended for the upper command (e.g., division) levels. Within the context of a simulated tactical operations system, several variables that were thought most likely to be affected by the use of reduced detail maps or echelon information needs were observed in an offensive planning phase and an offensive combat phase. Among the dependent variables included were number of data frames accessed, time to access data frames, and combat effectiveness scores. -> cont. next page		

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20. The analyses of variance performed on the variables show significant main effects for the echelon factor for the amount and type of information accessed, and for one combat effectiveness score. No significant difference in performance during planning or combat was associated with the level of map detail factor. Therefore, the feasibility of using reduced detail maps in conjunction with a computerized graphic display capability should be investigated. 

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## FOREWORD

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An important concern of the Battlefield Information Systems Technical Area of the Army Research Institute for the Behavioral and Social Sciences (ARI) is the man-machine interface in data processing and command/control decision making. Among the decision-aiding products and techniques which may help to improve this interface are computerized tactical situation displays, and a design and test methodology for developing new topographic maps for cathode ray tube (CRT) display. Topics such as these are being investigated within the context of ARI's Simulated Tactical Operations System (SIMTOS).

Topographic detail must be greatly simplified for any CRT display. However, essential information must remain available to the military user. This report investigates whether reduction of map detail reduces the efficiency of human information processing and decision making. Other ARI studies on tactical operations systems have been reported in ARI Technical Research Report 1156, Technical Research Note 227, Technical Paper 243, Research Problem Review 70-1, and Research Memorandum 74-7.

ARI research in this area is conducted as an in-house effort augmented by contracts with organizations with special qualifications in the field. The present project was done jointly, under the direction of James D. Baker, by personnel of ARI and the Essex Corporation, Alexandria, Virginia, and is responsive to requirements of TRADOC as well as RDTE Project Number 2Q763731A721, FY 1975 Work Program, "Man-Machine Interface Integrated Battlefield Control System."



J. E. UHLANER  
Technical Director

## A COMPARISON BETWEEN A STANDARD MAP AND A REDUCED DETAIL MAP WITHIN A SIMULATED TACTICAL OPERATIONS SYSTEM (SIMTOS)

### BRIEF

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#### Requirement:

To investigate whether reduction of map detail reduces the efficiency of human information gathering and tactical decision making in a simulated tactical operations system (SIMTOS).

#### Procedure:

Reduced detail maps and standard Army maps were used by 20 mid-level Army officers at division (G3) and regimental (S3) levels to complete planning and combat requirements specified in the current SIMTOS offensive scenario. A 2x2 analysis of variance design was used to evaluate the effects of the level of map detail and level of military echelon on variables likely to be affected in the information-gathering process of the planning phase and in the combat operations tasks of the combat phase.

#### Findings:

No significant differences in performance, amount of information requested, or time appeared between users of the reduced detail maps and the standard maps. For military echelon level, G3s asked for significantly more information in the planning phase than S3s; in the combat phase, officers who had acted as G3s previously had significantly better combat effectiveness scores than those who had acted as S3.

Some users of the reduced detail map subjectively judged their maps inadequate; however, the combat effectiveness scores indicated no significant differences in performance between those users and men who said they thought the reduced map was adequate.

#### Utilization of Findings:

Computerized graphics can be extremely useful in sophisticated military decision systems. However, standard Army topographic maps are too detailed to be used in cathode ray tube (CRT) displays. This investigation suggests that a reduced detail map can be substituted for the standard Army map at a division level in SIMTOS to satisfy hardware and software display requirements without degrading performance effectiveness. Further research should experimentally vary the computerized background display across several different military scenarios, taking special pains to make sure that the performance measures used are sensitive criteria.

If reduction of detail also increases legibility on hard-copy maps, the finding that it does not degrade performance may have useful implications for such fields as night operations or low-level helicopter flight where map visibility is a problem.

# A COMPARISON BETWEEN A STANDARD MAP AND A REDUCED DETAIL MAP WITHIN A SIMULATED TACTICAL OPERATIONS SYSTEM (SIMTOS)

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# A COMPARISON BETWEEN A STANDARD MAP AND A REDUCED DETAIL MAP WITHIN A SIMULATED TACTICAL OPERATIONS SYSTEM (SIMTOS)

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## BACKGROUND

As part of an effort to automate Army command and control systems, the U.S. Army Training and Doctrine Command (TRADOC) requested the Army Research Institute (ARI) to determine information requirements for a map display. As the first step, a group of military users and information sciences specialists met at Fort Belvoir, Virginia in June 1972 to develop recommendations for modifying tactical symbology for proposed tactical display devices. An ARI workshop then considered what details would be required on a situation map, in conjunction with the symbols, for optimum display of tactical information. The participants felt that in many cases certain topographic details could be deleted without reducing the map's usefulness, notably in many tasks of Staff Intelligence (G2) and Staff Operations (G3) officers.

A subsequent Modern Army Selected Systems Test, Evaluation, and Review (MASSTER) Test 142 meeting combined the conclusion of the two previous meetings, with input from experts in the field, and provided specific recommendations for reduced topographic background detail. These recommendations were followed for reduced-detail background slides in MASSTER Test 116, which investigated the use of automated displays in tactical situations.

One of the important conclusions reached in Test 116 was that the level of detail in standard Army maps seemed excessive for many tactical tasks. The Test 116 report recommended that level of map detail be studied to provide pertinent data for future automated display systems.<sup>1</sup>

Such an investigation of map detail is important. One reason for this is that concise presentation of necessary cartographic information should definitely help the user in tactical data systems. "Displaying data which has only potential relevance is not only ineffective but actually degrades performance. . . . Although unanticipated contingencies may require data which is not otherwise helpful, displaying all available data at all times may typically delay finding information."<sup>2</sup> This delay could be especially serious in a military decision context.

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<sup>1</sup> Aldrich, H. B., Larson, I. W., Kroger, M. H., and Sowell, E. N. IBCS: Automated Displays. Ft. Hood, Texas: Modern Army Selected Systems Test, Evaluation and Review Test Report No. FM 116, July 1974 (p. 22).

<sup>2</sup> Baker, J. D., and Goldstein, I. Batch vs. sequential displays: Effect on human problem solving. Human Factors. 1966, 3, 225-235.

Reduction of map detail also has a practical aspect concerned with automated displays. Computers have made it possible to automate any part of the tactical military decision-making process that could decrease the time to solution of problems or increase decision quality. However, the state of the art in computer graphics does not permit a cathode ray tube (CRT) to display all the information on a standard Army tactical map. The display system is not only limited by hardware capabilities but also by the visual and perceptual constraints of the user-viewer. A reduced detail map would be more amenable to display on a relatively small CRT.

A reduced detail display should of course not eliminate any information essential to a sound decision by the user.<sup>3</sup>

The primary objective of this research, then, was to investigate information acquisition and tactical decision-making effectiveness in a simulated tactical operations system (SIMTOS) situation under two map conditions: reduced-detail map and standard Army map. This was part of a continuing SIMTOS project at ARI.<sup>4,5,6,7</sup>

The most important question about reduced-detail map displays is whether their use reduces the efficiency of human information processing and decision making during tactical operations. This general question can be broken down into three more specific questions:

First, will the reduced display adversely affect tactical decisions? We must consider both the quality of the decision and the speed with which it is made. Second, how, if at all, will a reduced map display affect

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<sup>3</sup> Strub, M. H., and McConnaughey, P. Tactical planning (offensive and defensive) minimum essential information requirements. ARI Research Memorandum 74-7, October 1974.

<sup>4</sup> Krumm, R. L., Rowe, C. H., and Torpey, F. E. Research on tactical military decision making: I. Design of a simulated tactical operations system (SIMTOS). ARI Research Problem Review 70-1, October 1970.

<sup>5</sup> McKendry, J. M., Mace, D. J. and Baker, J. D. Implications of BESRL research for displays in tactical information processing. ARI Technical Research Report 1156, January 1969. (AD 688 581)

<sup>6</sup> Nawrocki, L. H. Alpha-numeric versus graphic displays in a problem-solving task. ARI Technical Research Note 227, September 1972. (AD 748 799)

<sup>7</sup> Nawrocki, L. H. Graphic versus tote display of information in a simulated tactical operations system. ARI Technical Paper 243, June 1973. (AD 766 217)

the user's search for information or the amount of information he believes necessary for making the decision? Third, to what extent will the user readily accept a map display that is considerably different from the type of map he is accustomed to?

## METHOD

### Subjects

A pool of potential tactical operations system (TOS) users was identified from the officer master file based on the following criteria:

Branch--Armor, Field Artillery, or Infantry

Grade--Major, Lieutenant Colonel, or Colonel

Military education--Command and General Staff College (CGSC)

Location--Washington, D.C. area

Service since 1963 as--battalion commander; brigade commander; operations and training officer (S3), brigade level; or G3, division level

From this pool, subjects who agreed to participate in the SIMTOS exercise were randomly assigned to one of four experimental groups, in a 2x2 factorial design. The experiment was concluded when reliable data had been obtained for 20 subjects, five in each cell of the 2x2 design, all of whom participated in both phases (planning and combat) of this investigation. Complete planning data for 27 subjects had been collected before the above data collection was completed.

### Independent Variables

The two independent variables in this experiment were:

1. Level of map detail (map condition)--standard and reduced
2. Military echelon--division and regiment

The first independent variable was used in both phases (planning and combat) of this investigation. The second independent variable was used only in the planning phase.

## Dependent Variables

The following dependent variables were selected to evaluate the information-gathering and processing aspect of the planning phase:

1. Time of first accession from the computerized data base
2. Time of 95% accession from the computerized data base
3. Time interval between first accession and 95% accession (Variable 2 minus Variable 1)
4. Time interval between first accession and last accession
5. Total number of unique data frames accessed (A data frame was defined as a CRT frame which displayed information concerning the simulated exercise. Each such frame was counted only once.)
6. Total number of unique data paths, all categories (In this investigation a data path was defined by the combination of data frames that represented a different branch in the tree-like structure of the computerized data base. Each data path was counted only once.)
7. Total number of unique data paths for G2 and G3 information categories
8. Average length of data path, for G2 and G3 information categories
9. Percent of data frames accessed in first 30-minute time block
10. Percent of data frames accessed in second 30-minute time block
11. Accession slope ratio (Variable 10 divided by Variable 9)

The following dependent variables were used to evaluate combat operations tasks in the combat phase:

12. Combat effectiveness score for defender forces
13. Combat effectiveness score for aggressor forces
14. Area captured by aggressor forces

Three experience variables, obtained by questionnaire, were used for the combat phase analysis:

15. Years of active duty
16. Years since CGSC
17. Number of tactical exercises in Germany

## Stimulus Material

The experiment used two typical SIMTOS stations (i.e., CRT with console keyboard, teletypewriter, a 1:50,000 kilometer map, and a 1:250,000 kilometer map). The only difference between stations was the type of map used. One station had two standard Army maps. The other station had maps with a substantial reduction of detail.

The reduced detail map was defined by criteria compiled as a result of the MASSTER Test 142 conference:

Topographic: Hill tops and bottoms, and slopes greater than 60°

Hydrographic: All bodies of water more than 60 feet wide

Transportation: All secondary and primary roads

Vegetation: All major vegetation areas

Man-Made buildings: Major towns

Map data: Grid lines ending in 0 and 5

The following categories of information were accessible through the computer:

G1, Personnel

G2, Intelligence

G3, Operations

G4, Logistics

G5, Civil Affairs

Fire Support Coordination

Chemical, Biological, Radiological

Engineer

Signal

Transportation

## PROCEDURE

The experiment consisted of two phases, offensive planning and offensive combat, conducted in two sessions. In the first phase the subjects were randomly assigned to one of two map conditions (reduced detail map or standard map) and to one of two echelon conditions (division or regiment). In the second phase all subjects in both map conditions were assigned to the division level.

The experimental day started with an introduction to the ARI mission, and with an explanation and demonstration of how to use the equipment. The experimenter verified that the subject knew how to operate the equipment, that he understood the requirements of the experiment, and that he was able to interpret the particular maps to be used.

Each subject was requested to complete planning and combat requirements as specified in the current G3 (Operations) offensive scenario. Offensive planning requirements included such tasks as a mission analysis, a recommendation of a form of maneuver, and completion of parts of an operations plan. Offensive combat requirements included such tasks as reorganizing and directing forces, and initiation of air strikes and artillery fires.

The planning and combat phases of the experiment were, to a certain extent, independent of each other. Before the start of the combat phase, the subject was told that he was to carry out a pre-selected plan of battle, not the one he had formulated during the planning phase. All subjects in the combat phase were given the same pre-selected plan. All subjects had access to the same computer-based information and military capabilities.

An experimental day (i.e., one planning and one combat phase) took about eight hours. During the experiment each subject received not only instructional materials, scenario descriptions, and organizational listings, but several questionnaire forms. The questionnaires were designed to obtain additional information about his decision behavior and military background and to help him subjectively evaluate SIMTOS and the reduced map display.

## RESULTS

Tables 1 through 11 show the results of the analyses of variance performed on the dependent variables in the planning phase. The military echelon factor yielded a significant F for Variables 5 (total number of data frames accessed), 6 (total number of data paths, all categories), and 7 (total number of data paths, G2 and G3 categories). For these variables the means of the G3 groups were greater than for the means of the S3 groups. This result was not unexpected; during planning, the S3 was in charge of one regiment, while the G3 was in charge of six regiments.

Table 1

SUMMARY OF ANALYSIS OF VARIANCE FOR TIME OF FIRST  
DATA FRAME ACCESSION, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	67.96	.30	
Level of Map Detail (L)	1	4.37	.02	
M x L	1	241.65	1.06	
Error	23	227.79		
TOTAL	26			

Table 2

SUMMARY OF ANALYSIS OF VARIANCE FOR TIME OF 95%  
DATA FRAME ACCESSION, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	8.95	.01	
Level of Map Detail (L)	1	508.48	.41	
M x L	1	2770.74	2.22	
Error	23	1246.72		
TOTAL	26			

Table 3

SUMMARY OF ANALYSIS OF VARIANCE FOR TIME INTERVAL BETWEEN  
FIRST AND 95% DATA FRAME ACCESSION, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	126.22	.10	
Level of Map Detail (L)	1	418.41	.32	
M x L	1	1375.18	1.05	
Error	23	1308.43		
TOTAL	26			

Table 4

SUMMARY OF ANALYSIS OF VARIANCE FOR TIME INTERVAL BETWEEN  
FIRST AND LAST DATA FRAME ACCESSION, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	859.50	.66	
Level of Map Detail (L)	1	14.22	.01	
M x L	1	2940.63	2.25	
Error	23	1305.02		
TOTAL	26			

Table 5

SUMMARY OF ANALYSIS OF VARIANCE FOR TOTAL NUMBER  
OF UNIQUE DATA FRAMES SELECTED, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	16436.44	8.13	<.01
Level of Map Detail (L)	1	960.08	.48	
M x L	1	5462.63	2.70	
Error	23	2020.76		
TOTAL	26			

Table 6

SUMMARY OF ANALYSIS OF VARIANCE FOR TOTAL NUMBER OF DATA  
PATHS FOR ALL CATEGORIES IN DATA BASE, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	10040.91	7.47	< .02
Level Of Map Detail (L)	1	1640.91	1.22	
M x L	1	2978.91	2.21	
Error	23	1344.88		
TOTAL	26			

Table 7

SUMMARY OF ANALYSIS OF VARIANCE FOR TOTAL NUMBER OF DATA  
PATHS FOR G2 AND G3 CATEGORIES, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	7008.51	9.86	<.005
Level of Map Detail (L)	1	27.66	.04	
M x L	1	2186.69	3.03	
Error	23	710.73		
TOTAL	26			

Table 8

SUMMARY OF ANALYSIS OF VARIANCE FOR AVERAGE LENGTH OF DATA  
PATHS FOR G2 AND G3 CATEGORIES, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	.00	.01	
Level of Map Detail (L)	1	.19	.98	
M x L	1	.00	.00	
Error	23	.20		
TOTAL	26			

Table 9

SUMMARY OF ANALYSIS OF VARIANCE FOR PERCENT OF TOTAL DATA  
FRAMES ACCESSED DURING FIRST 30 MINUTES, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	10.05	.02	
Level of Map Detail (L)	1	9.60	.02	
M x L	1	.02	.00	
Error	23	438.05		
TOTAL	26			

Table 10

SUMMARY OF ANALYSIS OF VARIANCE FOR PERCENT OF TOTAL DATA  
FRAMES ACCESSED DURING SECOND 30 MINUTES, PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	21.14	.23	
Level of Map Detail (L)	1	59.46	.65	
M x L	1	126.56	1.37	
Error	23	92.18		
TOTAL	26			

Table 11

## SUMMARY OF ANALYSIS OF VARIANCE FOR ACCESSION SLOPE RATIO (DEPENDENT VARIABLE 10 DIVIDED BY DEPENDENT VARIABLE 9), PLANNING SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	18.61	1.24	
Level of Map Detail (L)	1	10.69	.71	
M x L	1	19.41	1.30	
Error	23	14.99		
TOTAL	26			

One expectation was that the data path length for the S3 echelon would be greater than the data path length for the G3. This was based on the fact that the S3 was assigned tasks (i.e., tasks involving a river crossing problem) that were of a more specific nature, requiring more detailed information. As Table 8 shows, this was not confirmed.

For all eleven analyses in the planning phase it was hypothesized that the subjects in the reduced level map condition would access more information, for a longer time, at a faster rate, and in greater depth than subjects with the standard map. However, Tables 1 through 11 show no significant main effects for level of map detail. There were no significant interaction effects in the eleven planning variables.

In Figure 1, the accession rates for the various combinations of conditions are shown as a function of a standardized accession time base. (The curve plotting method is basically that of a Vincent curve.<sup>8</sup>) In terms of the overall trend in data frame accession in the planning phase, it seemed that the reduced detail map subjects tended to access data frames at an earlier stage than the standard map subjects. It may be that reduced detail map users were searching for information in the data base that is usually found on the map. Further investigations will try to objectively study this possibility.

<sup>8</sup> Woodworth, R. S., and Schlosberg, H. Experimental Psychology. New York: Holt, Rinehart and Winston, 1963.

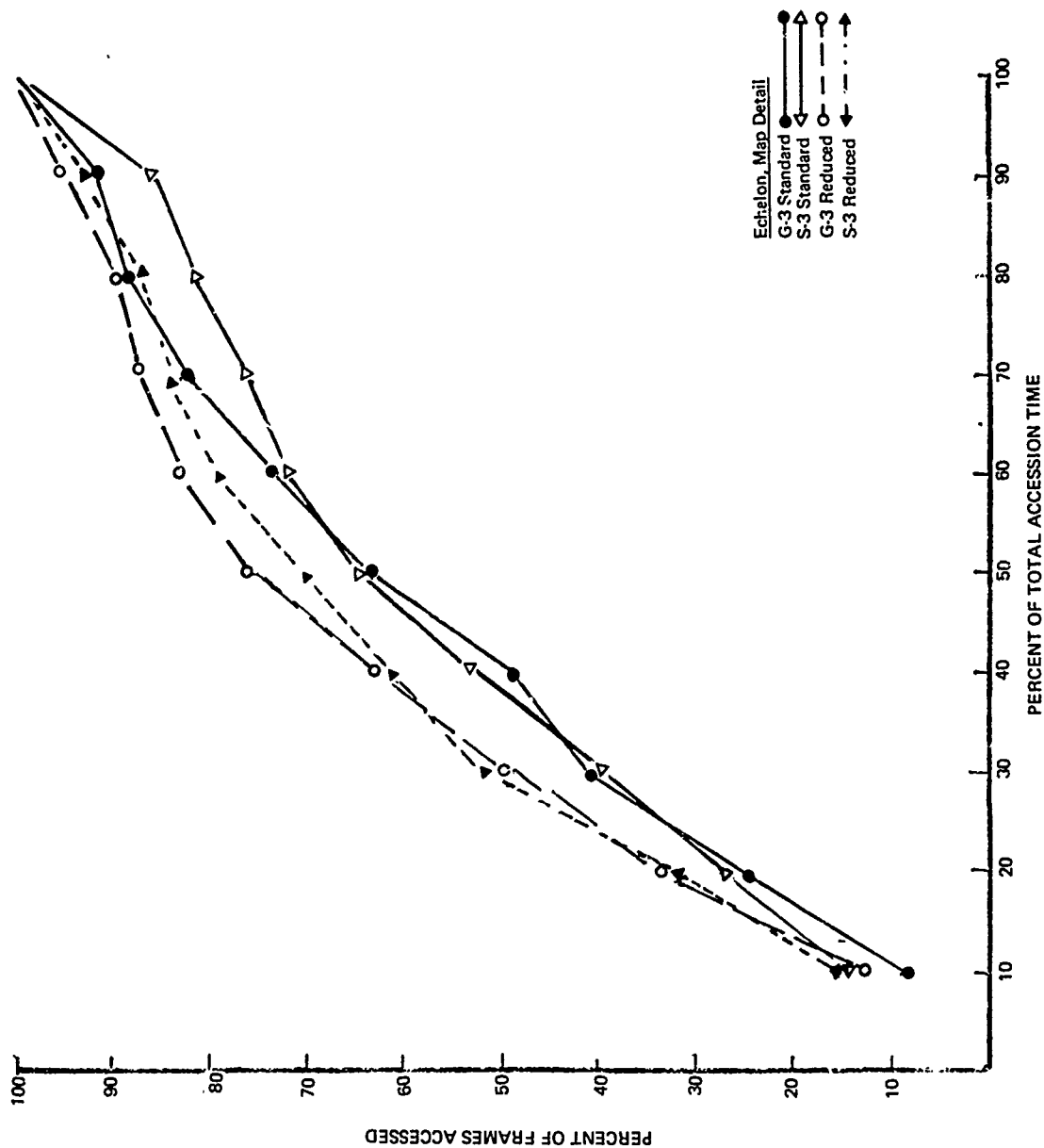


Figure 1. Averaged data frame accession functions for four treatment combinations in planning sessions. X-axis provides a standard scale to evaluate variable to accession time across Ss.

Because the military echelon variable was not studied past the planning phase, all subjects in the combat phase operated as G3s. However, the possibility that the information gathered by the G3 and S3 groups could affect the dependent variables in the combat phase was noted. Therefore, it was decided to continue the distinction between military echelons in the analysis of the combat data. Tables 12 through 14 summarize the analyses of variance for the combat phase variables. The only significant effect for the three combat variables occurred in relation to combat effectiveness for the defender forces (Table 12). A significantly higher score was achieved by the group that acted as G3 in the planning phase. It seems that within the SIMTOS scenario, use of the reduced detail map during the combat phase was neither a significant advantage nor disadvantage.

Table 12

SUMMARY OF ANALYSIS OF VARIANCE FOR COMBAT EFFECTIVENESS  
SCORE FOR DEFENDER FORCES, COMBAT SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	670.60	5.58	<.05
Level of Map Detail (L)	1	219.19	1.82	
M x L	1	4.11	.03	
Error	16	120.10		
TOTAL	19			

Table 13

SUMMARY OF ANALYSIS OF VARIANCE FOR COMBAT EFFECTIVENESS  
SCORE FOR AGGRESSOR FORCES, COMBAT SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	14.76	1.08	
Level of Map Detail (L)	1	10.66	.78	
M x L	1	2.22	.16	
Error	16	13.70		
TOTAL	19			

Table 14

SUMMARY OF ANALYSIS OF VARIANCE FOR AREA CAPTURED  
BY AGGRESSOR FORCES, COMBAT SESSION

Source of Variation	df	MS	F	P
Military Echelon (M)	1	4.21	.54	
Level of Map Detail (L)	1	22.62	2.93	
M x L	1	1.63	.21	
Error	16	7.73		
TOTAL	19			

Table 15 provides a correlation matrix for all dependent variables considered in the planning and combat phases. Calculation of the correlation coefficients was based on a sample size of 27 for the planning phases and a sample size of 20 for the combat phase. The correlation matrix in Table 15 also contains three experience variables obtained from subjects' questionnaires. It was thought that one or more of these variables might permit the use of the analysis of covariance in relation to the combat criteria. But, although Variable 17 (number of tactical exercises in Germany) does correlate .33 with Variable 14 (area captured by the aggressor forces), only 15 subjects reported data for Variable 17, with only 2 scores for one of the four cells. Therefore, a covariance technique was not used.

The correlation matrix revealed several items of interest. The combat variables were used on the basis of construct validity (Variables 12 and 13) and face validity (Variable 14) and were assumed to be independent.

The intercorrelations between the combat variables and the experience variables were rather low. This was due partially because of the restriction in range for Variables 15 and 16.

The correlation between area captured (Variable 14) and accession slope ratio (Variable 11) was large,  $-.58$ . However, it may be spurious and any post hoc explanation would probably result in matrix error. Other large correlations can readily be explained by interpretation of variable labels.

Subjective data was also collected regarding the respective maps. Subjects were asked what command level they thought was appropriate for the map they were using. There appeared to be no difference in the distribution of opinions (Table 16). Another question asked whether the subject's map was adequate. Table 17 shows that subjects using the reduced map seemed to judge their map inadequate more often than subjects using the standard map. However, t tests showed no significant differences in the three combat criteria scores between subjects using the reduced map who judged the map as inadequate and those who judged their map as adequate (Table 18).

#### IMPLICATIONS AND SUMMARY

The introduction of computerized graphic displays into a TOS-type environment can have many advantages. Among the advantages are the speed with which incoming information can be transferred to or reported on the display, the capability of storing much information and of retrieving the information when needed, and the possibility of dynamically re-displaying a series of past events for the purpose of analysis. For maps, these capabilities imply a topographic background against which to present military symbols. However, standard Army map detail cannot be presented on the CRT. An alternative to the standard map is a reduced detail map.

Table 15  
CORRELATION MATRIX FOR THE DEPENDENT VARIABLES FOR THE PLANNING SESSION (1-11)  
COMBAT SESSION (12-14), AND PERSONNEL EXPERIENCE (15-17)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Time of first data frame accession	1.00																
2. Time of 95% data frame accession	.20	1.00															
3. Time between first and 95% data frame accession	-.21	.91	1.00														
4. Time between first and last data frame accession	-.34	.65	.79	1.00													
5. Total number of data frames accessed	-.26	.11	.21	.59	1.00												
6. Total data paths, all categories	-.27	.15	.26	.58	.98	1.00											
7. Total data paths; G2, G3 categories	-.19	.24	.32	.62	.95	.94	1.00										
8. Average length of data path; G2, G3	-.25	.26	.35	.45	.27	.18	.25	1.00									
9. % accessions in first 30 minutes	.31	-.45	-.58	-.61	-.42	-.43	-.45	-.46	1.00								
10. % accessions in second 30 minutes	.09	.07	.03	.15	.30	.31	.27	.15	-.45	1.00							
11. Accession slope ratio (Variable 10/Variable 9)	.14	-.02	-.08	-.18	.00	.01	.01	-.01	-.41	.49	1.00						
12. Combat Effectiveness for Defender Forces	.27	-.08	-.17	-.01	.22	.25	.30	-.31	-.01	.30	.27	1.00					
13. Combat Effectiveness Aggressor Forces	.21	.12	.06	-.07	.01	.00	.00	.02	.06	-.06	-.30	.00	1.00				
14. Area Captured by Aggressor Forces	.13	-.17	-.22	-.04	.01	-.06	.10	.03	.24	-.24	-.58	.23	.20	1.00			
15. Years, active duty	-.23	-.03	.07	-.04	-.33	-.32	-.26	-.09	.01	-.33	-.18	-.27	.09	-.02	1.00		
16. Years, since CGSC	-.21	.00	.09	.07	-.02	-.02	.04	-.13	.07	-.17	-.04	-.09	-.15	.09	.65	1.00	
17. Number of exercises in Germany	.31	.12	.02	.01	.13	.05	.07	.13	.27	-.13	-.28	-.21	-.02	.33	-.05	-.03	1.00

Table 16

FREQUENCY OF RESPONSES TO THE QUESTION "AT WHAT COMMAND LEVELS DO YOU THINK THE MAP IS APPROPRIATE?"

Map Detail	Recommended Command Level					
	No Answer	Platoon- Company	Battalion	Brigade Regiment	Division	Corps
Reduced Detail	1	1	3	3	6	0
Standard	0	2	2	1	6	1

Table 17

FREQUENCY OF RESPONSES TO THE QUESTION, "WAS THE MAP PROVIDED TO YOU ADEQUATE FOR THIS EXERCISE?"

Map Detail	Planning Session Role	Opinion Of Map Adequacy	
		Yes	No
Reduced	G3	6	3
	S3	3	3
Standard	G3	6	0
	S3	6	0

Table 18

T-TEST RESULTS FOR MAP ADEQUACY AND  
COMBAT PERFORMANCE IN REDUCED MAP  
CONDITION MEASURES FOR TEN SUBJECTS

Combat Phase Variables	Opinion Of Map Adequacy	Mean	df	t <sup>a</sup>	P
Combined Effectiveness 16 CAA	Yes	106.98	8	0.40	NS <sup>b</sup>
	No	103.15			
Combined Effectiveness U.S. III Corp.	Yes	107.45	8	0.17	NS <sup>b</sup>
	No	107.02			
Area Captured	Yes	16.7	8	1.57	NS <sup>b</sup>
	No	13.8			

<sup>a</sup> critical value for  $t_{(.05,8)} = 2.31$

<sup>b</sup> NS=Non significant

Three questions, which were posed earlier, directly concern the advisability of using reduced detail maps in a command decision situation. The first asked whether tactical decision making would be affected by the use of reduced detail maps. From analysis of the combat data, it would seem not; there was no difference in performance between those subjects using the standard maps and those using the reduced detail maps.

A second question addressed the possibility that a reduced detail map could affect the user's search for information or the types of information retrieved from the data base. Planning-session data from this experiment indicated that subjects with the reduced detail map used the data base in the same way as those with the standard map. However, given the data in Figure 1 it is possible that the users of the reduced detail map did seek information in the computerized data base that was deleted from the map. However, subjects with the reduced-detail map did not use significantly more time to collect the information than those with the standard map.

The third question involved map acceptability by the user. Although subjective data indicated that some users doubted the adequacy of the reduced detail map, those who reported the map inadequate appeared to perform as well as those who reported the map adequate. Familiarity

with the reduced map might aid acceptability, especially if the user confirmed for himself that command decision-making performance was not degraded by the use of reduced detail maps.

When the variables that could be affected by the use of a reduced detail map were compared under reduced and standard levels of detail, no significant differences were found between them. The next appropriate step is to determine whether reduced detail maps can be used with a computerized graphic display system.

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